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BY

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SECTION D—ZOOLOGY

Presidential Address

THE ROLE OF ZOOLOGY IN THE FIELD OF MODERN BIOLOGY

By Professor E. J. GODDARD, B.A., D.Sc.

THE matter of determination of a suitable topic to furnish the basis for a Presidential Address to a Section of this Association is one demanding careful thought, designed to serve the interests of the Science concerned in the broadest fashion. The selection of such topic may be guided by one or several of a number of considerations, such as a conventional inclination to deal with a circumscribed field or group of specific research activities, or scientific developments in which the author has taken an active or preferential personal interest; the value of a critical review of the nature and progress of research and other activities generally within the ambit connoted by the designation of the Section; the desire to draw attention to matters pertinent to the welfare of the activities represented by the Section, and concerning the interests of the science involved; a re-alignment, review, or extension of the scope of activities within the science involved, in adaptation to new facies presented by problems, the appearance of new problems, or the advances made in other sciences, and suggesting new fields of activities or a new orientation of ideas; realization of the opportunity offered for relating the activities represented within the Section to the cultural, practical, economic, and/or administrative interests of the community at a time, and on an occasion, when public consciousness is awakened—at least temporarily—by the voice of Science; or recognition of the necessity for consolidating the status of Science by pressing its claims for an audition and participation in connection with the solution of many problems that are conventionally—but erroneously—interpreted and accepted as having no scientific background or interest, and by a straightforward and candid analysis of the incidences of scientific interests on those of the problems concerned, many of which are of fundamental importance and deep concern to human welfare and progress in their varied aspects, and to the well-being and organization of human society.

The rapid increase in number and development of specialized studies within the field of modern biology within recent years, and the concomitant development of applied and technical sciences within the same field, have resulted in a tendency towards an independence on the part of those activities by the assumption of a departmentalized status and manifestation of isolation from the parental science. We have to-day attained a position in that respect which necessitates a review of existing biological activities and a determination of the basis of inter-relationship that must operate in order to ensure effective co-ordination, as well as the development and utilization of biological science to full purpose in the interests of all aspects of human existence. The position is aggravated by the tendency to differentiate between so-called Applied and Pure Science, and to grant preferential treatment to activities relating to problems of an economic status to an extent that is excessive, in that commensurately little consideration is meted out to pure scientific biological research.

We are living to-day in a world disturbed by the manifestations and outbursts of emotional and passionate anthropocentrisms which, in common with other types of anthropocentrism, it is contended, are sustained by the adoption and exercise of ideas that are not altogether consistent with the findings and/or suggestions of biological science. It has to be recognized in any survey of biological science that while the latter must concern itself in meeting the needs of research and technical activities in the fields of Pure and Applied Science, it has also an important responsibility to discharge in the educational and cultural fields. It would appear that the world to-day is sadly in need of a more universal knowledge of biological data in the interpretation and elucidation of human problems. It is a strange, but nevertheless intelligible, fact that humanity has long since reached the stage, insofar as the so-called civilized world is concerned, when it is prepared through conviction to utilize scientific findings for the purposes of greater technical efficiency in relation to activities that concern the material interests of mankind; yet it refrains from applying, or lacks the courage to apply, biological findings to the interpretation and elucidation of the really fundamental problems that concern man himself. This state of affairs is due to the rôle played by superstition and its handmaid—slavish convention—supported by prejudices that serve the purposes of, and are utilized by, institutional interests, political expediency, and other vested activities, in a manner that betrays an almost complete disregard for scientific findings and established fact.

The two considerations to which reference has just been made, namely, that relating to the growth of specialization within the field of biological science, and that concerned with human biology, are closely inter-related in many respects; and they constitute matters of vital importance to zoological science. That fact, taken into account in conjunction with the occasion and location of this meeting, has suggested as a title for this address, 'The Rôle of Zoology in the field of Modern Biology'. The objective in this essay is to relate zoological activities on a basis of co-ordinated and co-operative effort, as well as effectiveness, to those manifold and varied interests that concern all aspects of humanity and human progress, and at the same time involve zoological consideration.

Biological science relates to the 'world of the living', which statement implies that it must concern itself with such matters as the characteristics, make-up and structure, potentialities, mechanisms, functions, manifestations, and patterns of behaviour, etc., of living matter. The 'living world', naturally, early gained a place in man's mind as a department of human interest in virtue of its possession, like man himself, of the quality of 'being alive'. The objects and materials on the earth were differentiated by him into two divisions—that of the 'living' and that of the 'non-living'—and he had little doubt in regard to the definiteness of the demarcation between them. With the passage of time, and aided by man's immortal handmaid and greatest asset—social inheritance—in ensuring the entailment of the observations, thoughts, experiences, and achievements of antecedent generations of men, there was built up a mass of knowledge concerning living substance that has enabled man, by the exercise of a vision of inter-dependence and inter-genesis, to read into the apparent heterogeneity and disruptedness of Nature a transparency and a wholeness.

The division between the inorganic or lifeless and the organic or living has become less and less definite, principles discovered in operation in the inorganic world have been found to apply in the organic. We view to-day the breaking-down of the conventional barriers between inorganic and organic substance—between the inorganic and the biological sciences. By virtue of their stimulating provocativeness and their richness in influential implications, the discovery of the cell and its eventual interpretation as the biological unit on which are impressed the potential specificities of the animal or plant species, the enunciation of the theory of organic evolution, the

elucidation of ontogeny and its bearing on phylogeny, the discovery of a physical basis of inheritance, the introduction of experimental methods, the application of biometrics, intensive specialization born of the mass of accumulated knowledge and the variety and nature of the problems arising out of that knowledge, the rise of the various applied biological sciences and the close association established between research and technical activities in relation to specific problems of a practical order—these, *inter alia*, have contributed materially towards fashioning biological science into a less exclusively descriptive and a gradually increasing group of interests of a more and more fundamental character. The entry of the non-biological sciences into the biological field is graphically illustrated by such appellations as biochemistry, biometrics, and bio-physics.

Biological interests to-day, whether of a concrete or abstract order, fall into two main fields, namely, that relating to the intrinsic problems of living stuff and that relating to the environment that conditions the exercise of the potentialities of that stuff. In the former field the non-biological sciences are being utilized to good purpose, and the future understanding of the problems involved would appear to be destined to depend more and more on highly specialized studies based on the inorganic sciences. The application of the same sciences to a thorough analysis of a multi-factorial environment is equally essential. A happy example of this is afforded by the utilization of physical science to-day in the production of special environmental conditions by means of radiation in relation to one of our major problems in medical science. The influence of radiations, in general, in Nature on the problem of mutation is a matter now attracting scientific attention, and the potentialities of such an analogous investigation cannot be exaggerated. Such considerations have their incidence in the past as well as the present. When it is borne in mind that past environments possess for the biologist as much interest as do the fossil remains themselves of animals and plants, it is then realized that biological science will much more seriously invoke the aid of a wider variety of non-biological sciences. Undoubtedly environmental conditions have played a most notable part in the evolution of the animal and plant kingdoms, and it is to be anticipated that one day it will be possible with the availability of exact knowledge concerning present and past environments, to relate the progress of evolution to environmental changes on an exact basis. Biological science is concerned with the gathering of knowledge concerning organisms, and the elucidation of all problems relating to living substance on a basis of that knowledge. It interprets the organism in terms of reactions between units of living material or integrations of such material, possessing general, specific, and individual qualities born of the distant and immediate past on the one hand, and a multi-factorial environment on the other. That attitude may savour of the doctrine of Determinism, but the biologist as such has no concern with metaphysical considerations that will interfere with the truly scientific outlook on his problems. He does not regard organisms and environment as fundamental concepts, but merely as convenient appellations. As independent entities they are inconceivable. Thus biological science stands for an attempt to relate all existing scientific knowledge to an interpretation of the problems associated with living matter. That knowledge and interpretation may find expression merely as an academic or philosophical interest, or it may be utilized in the direction of helping man in respect of his material wants and the amenities of a more satisfying human existence. Whatever be the objective interest we cannot afford to disregard the salient responsibility of biological science, namely, scientific attention to, and obssessing respect for, fundamentals. The proneness or tendency, these days, to utilize biological science along directly utilitarian lines is in every way desirable, in that biological science is enabled thereby not only to advance the conditions of human existence, and to contribute in a concrete fashion to the solution of problems of a practical, economic, and administrative order, but also is assisted gradually but surely to gain an audition and recognition

in those spheres of human interest where ignorance, superstition, and convention with their empirical trappings as represented in prejudices, vested interests, etc., have dominated man's outlook on problems that should be subjected to the same scientific treatment as his material problems. In fact, the two types of problems are inter-dependent and command an attitude of compatibility which is far from being realized hitherto. In that idea lies the settlement of the unjustifiable prejudices on behalf of, so-called, Pure and Applied Science—biological and non-biological. What is important is that the aspirations and usefulness of Pure Science, born of an obsessing enthusiasm and interest, should not suffer at the hands of an expediency that measures the economic value of biological activities by attributing them on an exclusive basis to the research and technical achievements within the fields of the Applied Sciences and those biological sections that have incidence on problems of an economic or practical order.

The functions of biological science in this human world relate on the one hand to utilitarian or applied aspects, whether in the field of the material or the humanitarian, and, on the other hand, to the cultural and philosophical aspects. In view of this dual functioning, a strong case might be established for the maintenance of biological science as an entity, rather than the disruption of a common field into two or more less independent groups of activities under the headings of zoology and botany. Zoology concerns itself with the application of those biological considerations previously mentioned to the study of animals. In that respect it represents one of the two major or parental divisions into which biological science has been parted. Its counterpart, botany, is by no means as sharply demarcated from it as the terms 'animal' and 'plant', and the specialized and technical activities represented within the applied biological sciences to which they have given birth, would appear to indicate. In fact, the division of biology into two separate sciences—we subscribe to the use of the term merely for the sake of convention—is based on ideas that serve the conveniences of a time-period rather than the purposes of a science concerned with organic as opposed to inorganic forms. To-day we can regard zoology and botany as the two main, somewhat specialized, categories of biological activities, mutually overlapping in regard to the domain of living forms, and based on the operation of many common and analogous principles pertinent to the characteristics, potentialities, etc., of living matter. I am one of those who have long been convinced of the scientific advantage of combining botanical and zoological studies on a common fundamental basis. That attitude receives much support to-day from the appeal for more effective co-ordination of scientific activities. Such a biological union would in no way interfere with the intensity of interest and activities relating to the spheres of animal and plant studies, and could be utilized by rational organization to stimulate the development of specialized and applied scientific studies with a greater assurance of co-ordination, more attention to the comparative and fundamental scientific outlook, than obtains to-day.

With the growth of scientific knowledge, specialization in biological science became inevitable. In so far as zoology is concerned, among the various considerations that have stimulated and consolidated this practice of specialization, may be mentioned the importance numerically, economically, or otherwise, of some particular group of animals, as in the case of insects, domesticated animals, parasites, fishes, etc.; the benefits of circumscription of activities and studies in the direction of greater proficiency and thoroughness of knowledge, and the increased efficiency of research and technical scientific workers; the application or implementation of some new idea or technique; the manifold aspects and complexity of some fundamental studies; circumscribed biological interests such as biochemical, bio-physical, practical, or economic; assumed fundamental importance of some particular group, problem, aspect, etc. These various specializations are found to vary in respect of their intensity, isolation, and independence in relation to biological

science generally, relative dominance of research or technical interests, directness of practical, economic, or humanitarian value, specialization of training required, fundamental scientific value, comparative scientific value, intimacy of relationship to non-biological scientific activities, professional or occupational value, etc.

There is a host of these specializations, each carrying its own dignified title, that would be at once accepted as falling within the realm of zoology, and can be undertaken by a trained zoologist. But there are some biological specializations that, although intimately related to zoology, have acquired a number of characters, mainly of a technical and professional order, that have assumed an independence of their own. These are well exemplified in the case of medical science and that of veterinary science. The development of these applied biological sciences, assisted to some extent by zoological activities of a less independent order but having economic significance, has exercised an influence in respect of zoology in several directions. In the first place they have established in the community a respect for, and appreciation of, the value of at least certain aspects of zoology. This is due to the fact that these applied biological sciences have brought into existence professional workers who have become increasingly efficient in the field of technical activities. Each of them has assumed responsibility for certain types of research, technical, and educational activities, and is constantly engaged in relating the results achieved by research and technique to the problems and concrete interests of the community. To-day there is universal acceptance by the laity of the value of these activities, and, consequently, there are no political hindrances to any attempt on the part of governments to give increased support to applied biological science. Further, appreciation of their value to the community finds expression in the voluntary contributions made by organizations and individuals to the cause of research, as well as in the employment of research workers. In the second place, these applied sciences have exercised a beneficial influence in encouraging or accelerating in the field of academic zoology an attitude of mind that respects more the quantitative as against the purely descriptive or speculative, and has led it to disown spiritual opposition to investigations having a utilitarian or economic background, and yet requiring the assistance of the fundamental scientific worker. Thus academic zoology has become in some way more purposive, and that position has been materially assisted by the fact that the applied sciences have been enabled to present many problems of interest to the zoologist. While these applied sciences owe much of their scientific advancement to the pure sciences, yet a very considerable amount of research work is carried out, and a high standard of technical efficiency attained. Their responsibilities towards problems of a practical nature have, in their discharge, resulted in the accumulation of valuable and reliable data having a special interest for the zoologist not only in the way of knowledge but also in stimulating comparative research.

On general grounds the growth of the applied biological sciences related to zoology, and the tendency of the former to segregate themselves more and more from the real and parental science to which they belong, namely, zoology, would appear to be due to the following considerations:

1. Economic or other practical aspects of specific problems demanding the adaptation of general and fundamental knowledge.
2. The natural result of intensive specialization.
3. The demands for technical efficiency, and the need for a practical and intimate linkage of research and technical activities.
4. The academic and restrictive inclinations of Pure Science.

It would now appear that this segregation has reacted to the mutual advantage of all the activities involved, but that a stage has now been reached where the advancement of knowledge, nature and quality of problems, and cognate interests suggest the advantages of a return of all the sciences involved

to a closer association and practical inter-dependence that will give expression to the intimate and intrinsic inter-relationship of the fundamental and the comparative viewpoints.

In the case of medical science, special considerations, in addition to those of a general nature indicated previously, have operated to isolate it from the broad field of biological (or zoological) science. Its ancient origin, its early empirical make-up, its superstitious entanglements, and its domination by the anthropocentric beliefs of past and present times, as well as professional interests associated with its practice, have been special factors accentuating its isolation. On all sides there are advancing reasons compelling a closer association of medical science with biological science in general. There is developing to-day a field of activities relating to man that may be most aptly described in the category of human biology, which is demonstrating the significance of the comparative biological outlook in its application to man, and which must impinge on the fields of any circumscribed medical science. Further, medical science shows signs of recognizing the necessity for an expansion of its outlook so as to take within its ambit a wider interpretation of its responsibilities than is connoted by merely technical activities.

Largely due to the isolation of medical science from the field of biological science in the past, there has been an unnatural divorcing of physiology from zoology. In the case of botany we find that plant physiology has been rightly maintained as a major activity, and has contributed very considerably to the advancement of that biological division. There is to-day serious scientific demand for a broader or comparative physiological outlook in regard to zoological activities, and in that connection more serious attention must be given by the universities to the development of comparative physiological activities in order to provide a more truly zoological training, and at the same time meet the needs of many problems of a practical and economic order which demand a foundational knowledge of comparative physiology. There are on all sides signs of appreciation of this neglected corner of the field of zoology.

It would appear in so far as the applied biological sciences are concerned that their relation to the general field of zoology should be comparable to that of engineering to physics and chemistry, etc.

Scientific activities within the field of zoology and the cognate applied sciences fall, independent of their professional aspects, into three categories, namely, research, technical, and educational. The associated scientific problems fall into two categories, namely, research and technical. These are terms of convenience, and cannot be regarded as being based on any definite line of demarcation between them. A special difficulty accrues from an arbitrary or conventional use of the term 'research'. Research in its strict sense, should connote investigational activities applied to the discovery or elucidation of scientific principles or the gathering of basic factual knowledge; the term 'technical' would appear to be applicable to activities concerned with the application of such principles or basic knowledge to concrete problems or tasks, or to the extension of knowledge. To-day we find the term 'research' applied to a very diverse assemblage of activities—some relating to fundamental investigations concerned with the objective of discovering some new principle or basic fact, and having no conscious connection with any practical problem, and no primary interest in any utilitarian goal; those concerned with fundamental investigations designed to assist in the elucidation of some practical problem, or to serve some specific utilitarian purpose or interest; and, lastly, those which consist in the application of existing basic knowledge or accepted principles to investigations, the purpose of which is, in the main, to increase the stock of exact knowledge. The last-named may call for judgment and special aptitude, and do demand accuracy of observation and description, but their prosecution is effected by methods that savour of routine born of training or experience rather than originality of a high order. They are well exemplified in the determination and description of species, anatomical

investigations, etc. There is a host of zoological activities, frequently spoken of in the category of research, that conform to the scientific standard just mentioned, and which should be classed as technical.

The term 'technical' is applied to a variety of activities which relate to several types or grades—one demanding a quality or acumen that is closely analogous to originality, the other being mainly of a routine order, but calling for judgment and special aptitude. The former can lay greater claim to the status of research than can certain types of so-called research.

All these types of activities—research and technical—demand scientific training and knowledge, of a variable order. The use of the terms has become largely conventional and has been somewhat influenced by the institutional associations of the various types of activities, by relation to the fields of Pure and Applied Science respectively, etc. The matter is one of considerable importance in several directions, in its bearing on the status of scientific services, its relevance to the problem of inter-relationship and co-ordination of pure and applied scientific activities, the question of allocation of the various types of activities within the Commonwealth on an institutional basis, the economic co-ordination of all institutional activities, etc. One consideration in that connection merits mention, and it is that efficient technical service must be scientific. If the needs in respect of such services are to be met, it is essential that consideration be given to the matter of valuating technical services on a more rational basis than that of a differential order, as between technical and research activities, as practised to-day. It would appear that this differentiation is based, in the main, on habit or vogue.

There is manifest on all sides a recent attitude in relation to biological problems that finds expression in utilizing all types of scientific activities in the interests of problems after such problems have been defined, rather than allocating problems on a basis of departments of science. That attitude is of advantage not only to problems themselves but also in breaking down any frontiers within the broad field of science generally. Biological science has much to gain by that development, and will be encouraged to avoid the dangers that accrue from professional circumscription of activities of a biological order. Here again the argument advanced in the direction of effecting a closer co-ordination of pure and applied zoological activities is accentuated.

To-day there are operating within the Commonwealth many varieties of pure and applied zoological activities under the aegis of universities and other institutions, State and Commonwealth organizations and departments. It is in the interests of zoological science in general that a basis of co-ordination of these activities should be established in such a way as to meet the needs of the Commonwealth and its component parts in respect of supply and utilization of scientific personnel—research and technical—and at the same time satisfy the demands of economy and efficiency.

While it is recognized that the development of the many scientific specialities operating to-day in research and technical activities has materially contributed to world progress, and the amenities of human life, and has exerted a healthy influence by emphasizing the reality of efficiency, it is becoming realized that greater co-ordination and co-operation is essential in the interests of balanced and effective scientific effort. Technical advancement enjoys a prolonged hey-day as the result of one discovery of fundamental and novel importance which provides for a host of technical activities. But that hey-day has its limitations despite the amount and brilliance of its achievement.

We must then await another fundamental discovery. Fundamental research must be actively and continuously fostered and, further, its relations to technical activities must be maintained on a basis of intimacy and co-operation. There is serious danger in the assumed independence of technical activities and the applied sciences, and in their divorce from the fundamental sources to which they must always recognize their indebtedness. Science

would not relate itself effectively to world progress and achievement without the aid of the technician and applied scientist, who again would become increasingly less efficient without the help of the fundamental scientist. The applied scientist should function, as previously stated, within the biological field as does the engineer within the physical field. The applied biological sciences as they become more and more efficient scientifically in respect of research and technical interests, become more and more specialized, and consequently, less and less comparative.

It is to the universities that we must look in the main for the training of our research and technical scientific personnel within the field of zoology, pure and applied. Within our universities facilities are provided in that connection through departments of zoology or biology and various departments within medical and veterinary schools. The nature of the scientific activities therein relates to varying grades of research and technical investigations. The universities are of a provincial nature, and their main function is that of scientific instruction and training. They are expected to provide the community with the requisite research and technical personnel. The matter of research is left in the hands of the individual departments which are consequently enabled, where inclined, to devote themselves to fundamental investigations. This is materially assisted by the fact that such researches are optional and are free from any time pressure or any analogous cramping or harrying influence. There is the added advantage that, at least, the possibilities for the creation of an atmosphere of fundamental scientific research obtain, and that in that connection there are available inter-departmental facilities. The main disabling factors to-day are the time-absorbing duties of a tutorial and administrative nature, the lack of financial encouragement offered to post-graduate research students, the paucity of students attracted to the university and possessing the requisite ability and aptitude for research (while being prepared to devote themselves to fundamental scientific research), and the lure of many suitable students by the professional aspects and advantages of a training in some applied biological science, as well as the sparseness of suitable and adequately recompensed posts in the field of Pure Science. In this country there is no appreciable leisured section of the community free to indulge its interests, or furnished with the thoughtful desire to pursue scientific studies of a pure order, as a serious hobby or occupation.

The problem of the availability of suitable and proficient man-power for research is to-day one of extreme seriousness. The position is being faced by the Commonwealth by the provision of assistance for the training of research workers as well as for research by the personnel of the university. This assistance takes the form of financial help made available to the universities through the Council for Scientific and Industrial Research and the Medical Research Council. But that scheme is not without its defects, in that special pleading becomes necessary in order to ensure that some fundamental research project having no apparent or potential utilitarian value is favoured by the essential financial help. It is granted that finance always has its limitations, that the financial requirements for scientific research are practically unlimited, and that consequently there is some justification for administrative control by the donors, or their representatives, in an attempt to ensure the maximum of concrete economic return, and to obtain political blessing for the financial contributions offered. Yet such procedure is in principle incompatible with the procedure and attitude, historically justified, essential in the interests of scientific research. It throws unfair obligations on the universities, which must carry the main responsibility for fundamental researches, and which become dependent on such private benefactions as have been granted with broad vision and left for such specific utilization as the university desires. It is, however, natural to expect that benefactions will be made generally under a stipulation that they be devoted to some specific purpose, and that purpose will in most cases relate to activities of an

applied or practical order. It is therefore reasonable to expect that the interests of fundamental research should become, and be regarded as, a national obligation, and that such obligation should be met in true national fashion.

The universities are fully alive to-day to their responsibilities in so far as State interests are concerned, and should be in no way cramped in their planned desire to serve those interests in the manner that appeals to them as most purposeful. Anything that tends to circumscribe university outlook or activities undoes the true function of the university, and that statement has special relevance to the field of pure or fundamental research. There is to-day an evident tendency to degrade our universities to the basis of technological institutions. The attainment of that objective or inclination will be fatal to the interests of science, both in respect of scientific achievement and the training of research students. We grant that our universities must contribute towards the advancement of technical efficiency by providing the necessary trained and proficient man-power, but the universities must enjoy the fullest freedom in the exercise of their responsibilities, in the interests of scientific research and training. That of course does not involve the idea that the universities should not be requested to give attention to some specific task for which they happen to possess the most efficient facilities and available abilities.

Zoological science stands firmly by the theory of organic evolution, and, *ipso facto*, adopts the implications of that theory in relation to man. Consequently the attitude of the zoologist, as an animal biologist, towards the biology of Man—and that involves varied individual and societal aspects of human existence and human problems—is one based on the adoption of the comparative outlook. In that respect zoology takes up a position of positive opposition to any form of anthropocentrism that is based on a disregard for, and/or a refutation of the facts and principles of organic evolution in their application to Man. Further, it can detect in all forms of anthropocentrism many spuriously-fundamental and unscientific attitudes in the analysis and treatment of human problems, that can yield no satisfactory solution of those problems. There are few parts of the world to-day that are not suffering under the influence of some form of anthropocentrism, although individual parts are not merely complacently, but positively, convinced in times of international misunderstanding—and individual sections of such parts equally positively convinced in times of sectional schisms of a varied order—that their outlook alone is sound and right—in an absolute sense.

Historical approach to the study and thorough analysis of any problem is, in our human experience, not surpassed by any other method, and consequently cannot be lightly disregarded in the study of Man. Factual history supports the contention of reason and experience that no species of anthropocentrism has ever attained or ever will attain, a status of catholicity. While a psychology of anthropocentrism obtains there will always be many 'anthropocentrisms', and a basis for human schisms and internecine strife perpetuated.

Anthropocentrism by its self-centred and exclusive attitude and by its disregard for comparative methods and values, provides a prolific genetic basis for the birth and sustenance of 'superiorities' and 'prejudices'. The passage from the anthropocentric attitude (which attempts to bestow a false dignity on man in virtue of his assumed, and dogmatically proclaimed, isolation from the rest of the animal kingdom) to the idea of national superiority, racial superiority, religious prejudices, occupational prejudices, sex prejudice, family prejudice, etc., is, psychologically speaking, easy and, one might hazard, inevitable.

It is to be granted that 'anthropocentrisms' have exercised benefits by their adaptation to the needs of a time-period, and it is significant that as new species have arisen, certain salient and novel features in their constitution manifest that adaptation. No doubt the incorporation of those features has

been based on a desire and effort to pursue a path of progress in an interested or disinterested fashion. There are signs of change to-day, and that change is due to the gradual infiltration of the scientific attitude, and is reflected in an increasing realization of the manifest effiteness of much that constitutes our social environment. It is good that that change should follow evolutionary lines, and that any sudden spurts or saltations should be allowed time for effective adaptation of themselves.

We are to-day living in a time-period that finds the civilized world, badly as it needs—and will always need—reorganization, threatened by a concatenation of obsessions and ebullitions, born of a species of anthropocentrism that assumes the guise of a sublimation in the minds of its creators and adherents, and, consequently, finds full justification for the implementation of its ideals under the urge of that emotional prejudice and enslavement that inevitably characterizes any form of anthropocentrism.

The attitude of zoological science towards man and his problems is based on the same principles, in the main, as is its outlook in interpreting the problems of any other species of animal. While taking cognizance of the special complexities that obtain in relation to man, that interpretation, nevertheless, is based on attention to the universal forces of heredity and environment. It is recognized that man's inheritance is unique in that it falls into two categories—biological inheritance and social inheritance. Biological inheritance subscribes, in the case of a man, generally speaking, to the same general formulae as in the case of other animals, that is, it carries the impress of individual and immediate ancestry imposed on the matrix of animal ancestry long established. Social inheritance, as represented in human institutions, *mores*, beliefs, etc., gains its title from the fact that it represents an entailment of experiences, thoughts, and achievements from previous generations, and is thus justified as inheritance in virtue of the possession of the quality of transmissibility. From a biological view point, strictly speaking, social inheritance assumes the rôle of environmental influences, distinct from those of the inorganic environment. Both these types of environment, like biological inheritance itself, are complex in constitution—multi-factorial in make-up.

Insofar as biological inheritance is concerned, the time has arrived, long since, when a civilization that can boast of so much achievement in the technicalities of the inorganic and the less-than-human organic spheres should lend an ear to the potentialities of zoological science in its application to man. A future President of this Association, in an address dealing with the 'History of Science in Australia' might well draw attention to the inhibitions imposed in these times on such application. The applicability of the knowledge available in connection with plants and animals to the problems of human inheritance has been demonstrated beyond dispute; yet—crude as it may sound—not only is no positive and constructive effort made to implement such application, but anthropocentric conceit, institutional interests, and various other considerations are permitted to inhibit any attempts at such implementation. It is ironical that with the scientific knowledge available we should strenuously assist the efforts to apply the laws of heredity and the principles of scientific breeding to plant and animal problems, and, at the same time, perpetuate human misery, accelerate race deterioration, and subscribe to uneconomic administration in supporting such policy, while boasting of our increasingly humanitarian outlook. Those obsessionists who take up an exclusive attitude on behalf of heredity and environment respectively in the determination of the quality of the individual, betray thereby their political caste, prejudices, and unscientific extremism. Both influences or forces—heredity and environment—merit equal consideration, a statement that must be qualified by the thought that in individual or specific directions one of them may exercise a major determination. Yet in a general conspectus the statement must be upheld. Consequently, exclusive attention to the problems of environment cannot be justified, even on 'spuriously'

humanitarian grounds, simply because they are politically expedient, and the implementation of genetic principles politically inexpedient. These are matters that medical science—and particularly those sections which are concerned with preventive and social medicine—should press with preferential vigour. The problems of human inheritance should play a much more important part than they do in the field of clinical medicine. There is good reason for believing that the application of genetics to such will materially assist the problem of diagnosis, not only in the case of physical but also mental distress, by the utilization of a referential basis involving the idea of human types or groups, as well as the collating of familial data. There is in that connection need for biometric services and for a biological outlook. The field of human genetics opens up an enormous number of problems that merit research of a fundamental order, and in that connection attention to the comparative viewpoint must be sustained. Such problems as those relating to certain types of mental aberration and involving consideration concerning the physical basis of inhibitions, reversion in respect of mental and structural features to lower types (even to the Neanderthaloid), racial admixture considered from such standpoints as those of heterosis (hybrid vigour) and dis-harmony—these serve to illustrate the abundance and variety of problems, and to indicate the necessity for a biologically planned and executed survey. Genetical studies are characterized by an exactitude that will bestow on the results yielded by them a compelling influence in the direction of a biological, as opposed to a circumscribed medical, outlook on the problems of Man.

Insofar as the inorganic environment is concerned, medical science is now manifesting a broad as well as intensive interest. The idea of surveys carried out in accordance with the principles of biological procedure is now being implemented, and in that connection we find the services of the physiologist and biochemist as well as those of the clinical research and technical officer employed. This represents a step towards building up a group of co-ordinated activities which might be regarded as human ecology. The development of that group of activities to the status of proficiency that the interests of Man demand will provide data of inestimable value to biological science in general. It is equally certain that it will react by stimulating interest in the direction of organizing investigations within the field of human genetics.

While the application of ordinary zoological procedure to man will concern itself with matters relating to the provinces of heredity and inorganic environment, it takes cognizance of the potency of social inheritance, and in that connection realizes the necessity for an organized study of Man that will consist in a co-ordination and co-operation involving biological science, and the various social sciences relevant to Man's societal existence. It is realized that evolutionary forces operate in relation to Man himself, and his inorganic environment. In so far as social inheritance or environment is concerned, political activities and reviews are constantly effecting change. There is need in the latter connection for a closer co-ordination with general biological interests. Realization of this is manifest in the co-ordinated grouping of the interests associated with biological and social sciences in relation to Man, and finding expression in some parts of the world in the organization of what is aptly termed to-day human biology.

The world to-day is divided on international lines by prejudices, anthropocentrisms, and schisms of a varied order that have their analogies within the domestic or national sphere in individual countries. National prejudice, racial prejudice, etc., have their counterpart in the various prejudices that disturb the unity of nations individually and their component communities. They all have a common psychological basis, one that is intimately bound up with obsessions that are to be found associated with an anthropocentric outlook, and one that operates in opposition to, ignorance of, or spurious interpretation of, Man's biological make-up and significance. One of the important rôles of zoology would then appear to be that concerned with the

dissemination of zoological or biological knowledge relating to organic evolution, and consequent insistence on the adoption of the comparative outlook in relation to Man and human problems. In that way zoological science can do much towards devising a thermostat for regulating the moods and modes of a mercurial world.

The rôle of zoology in the field of modern biology would then appear to consist in the following responsibilities :

1. To function truly in the capacity of animal biology, and in that connection to exercise its manifold activities towards the attainment of an interpretation of the animal world in terms of fundamentals, and the discovery, elucidation, and dissemination of principles that will enable us to envisage with scientific precision the inter-dependence and inter-reaction of the animal organism or individual and its environment.
2. To pursue those objectives with practical realization of the inter-dependence and inter-genesis that relate all that is in Nature to an entity, and in that undertaking to invoke and utilize the manifold stocks of exact knowledge and scientific activities that are available.
3. To discard any classification of scientific activities based on a differentiation into Pure and Applied categories, and thereby to engage in all classes of activities that, by adding to the stock of exact knowledge in relation to animal biology and the application of such knowledge, will contribute to all aspects of cultural, economic, and humanitarian progress and interest.
4. To provide a fundamental background of knowledge by the correlation of the data made available by the various specializations within the field of animal biology.
5. To inculcate and disseminate biological knowledge and principles in their bearing on the problems and nature of Man as an individual and a societal organism.
6. To contribute towards a philosophical conception of Nature.